CLAIMS

1. A method for the endothelium-preserving treatment of hollow organs, comprising contacting an isolated hollow organ with an endothelium-protective perfusion solution, wherein the endothelium-protective perfusion solution comprises at least the following components:

   (a) physiological electrolyte solution
   (b) at least 0.1% per weight of native albumin
   (c) nutrient substrate;

   wherein the treatment results in a preservation and/or repair of the endothelial tissue in the lumen of said hollow organ.

2. The method of claim 1, wherein said native albumin in said endothelium-protective perfusion solution is replaced by 1-10 vol-% homologous hemolysin-free serum or autologous serum.

3. The method of claim 1, wherein said native albumin in said endothelium-protective perfusion solution is replaced by a homologous anti-coagulatory blood plasma preparation, which comprises human plasma proteins, anti-coagulatory-acting factors and immunoglobulins, and in which the pro-coagulatory-acting factors, isoagglutinins and instable components of the blood plasma have been removed.

4. The method of claim 3, wherein the anti-coagulatory blood plasma preparation contains sodium ions, potassium ions, calcium ions, magnesium ions, chloride ions, human serum proteins, albumin and immunoglobulins.

5. The method of claim 4, wherein the anti-coagulatory blood plasma preparation comprises the following composition: about 100-170 mM sodium ions, about 1-15 mM potassium ions, about 1-6 mM calcium ions, about 0.1-4 mM magnesium ions, about 50-200 mM chloride ions, human serum proteins with about 25-45 g/l albumin, 3-15 g/l IgG, 1-10 g/l IgA and 0.2-3 g/l IgM immunoglobulins at a pH value of about 7.3 to about 7.8 and an osmolarity of about 200-350 mosmol/kg.

6. The method of any one of claims 1-5, wherein said nutrient substrate in said endothelium-protective perfusion solution is L-glutamine.

7. The method of claim 6, wherein the concentration of L-glutamine in said endothelium-protective perfusion solution is 0.5-10 mM.

8. The method of claim 6, wherein said physiological electrolyte solution contains 2-10 mM glucose and/or 1-10 mM pyruvate.

9. The method of claim 6, wherein said physiological electrolyte solution contains 0.1-0.6 U/ml heparin and/or 50-100 μM of each of uric acid and/or ascorbate.

10. The method of any one of claims 1-9, wherein said physiological electrolyte solution comprises the following components: 100-150 mM NaCl; 1-15 mM KCl; 0.1-4 mM $MgSO_4$; 0.5-2 mM KH_2PO_4; 24-48 mM histidin-Cl and 1-3 mM $CaCl_2$.

11. The method of claim 1, wherein the endothelium-protective perfusion solution is an anti-coagulatory and non-agglutinating blood plasma preparation, comprising human plasma proteins, anti-coagulatory-acting factors and immunoglobulins, and in which the pro-coagulatory-acting factors, isoagglutinins and instable components of the blood plasma have been removed.

12. The method of claim 11, wherein the blood plasma preparation comprises the following components: 100-170 sodium ions, 1-15 mM potassium ions, 1-6 mM calcium ions, about 0.1-4 mM magnesium ions, 50-200 mM chloride ions, 25-45 g/l albumin, 3-15 g/l IgG, 1-10 g/l IgA and 0.2-3 g/l IgM immunoglobulins.

13. The method of claim 12, wherein the blood plasma preparation was treated with β-propiolactone and UV-radiation for virus inactivation.

14. The method of any one of claims 1-13, wherein said perfusion solution contains one or more endothelium-promoting growth factors.

15. The method of claim 14, wherein said growth factor is selected from the group consisting of epidermal growth factor (EGF), fibroblast growth factor (FGF), vascular endothelial growth factor (VEGF) and stem cell factor (SCF).

16. The method of any one of claims 1-15, wherein said perfusion solution contains flavonoids.

17. The method of claim 16, wherein the flavonoid is quercetin and/or trihydroxyethyl rutoside.

18. The method of any one of claims 1-17, wherein said perfusion solution contains papaverin and/or adenosine.

19. The method of any one of claims 1-18, wherein said perfusion solution contains cardioplegic concentrations of potassium of more than 6 mM.

20. The method of any one of claims 1-19, wherein said hollow organ is a heart, intestine, uterus, kidney, bladder, lung, liver, spleen.

21. The method of any one of claims 1-19, wherein said hollow organs are biological vessels.

22. The method of claim 21, wherein said biological vessels are blood vessels or lymphatic vessels.

23. The method of any one of claims 1-22, wherein said endothelium-protective perfusion solution is directed through the hollow organs by means of an apparatus according to any one of claims 47-51.

24. An endothelium-protective perfusion solution comprising:

(a) physiological electrolyte solution
(b) at least 0.1% per weight of native albumin
(c) 0.5 to 10 mM L-glutamine

25. The perfusion solution of claim 24, wherein said native albumin is replaced by 1-10 vol-% homologous hemolysin-free serum or autologous serum.

26. The perfusion solution of claim 24, wherein said native albumin in the endothelium-protective perfusion solution is replaced by a homologous anti-coagulatory blood plasma preparation, comprising human plasma proteins, anti-coagulatory-acting factors and immunoglobulins, and in which the pro-coagulatory-acting factors, isoagglutinins and instable components of the blood plasma were removed.

27. The perfusion solution of claim 26, wherein the anti-coagulatory blood plasma preparation contains sodium ions, potassium ions, calcium ions, magnesium ions, chloride ions, human serum proteins, albumin and immunoglobulins.

28. The perfusion solution of claim 27, wherein the anti-coagulatory blood plasma preparation comprises the following composition: about 100-170 mM sodium ions, about 1-15 mM potassium ions, about 1-6 mM calcium ions, about 0.1-4 mM magnesium ions, about 50-200 mM chloride ions, human serum proteins with about 25-45 g/l albumin, 3-15 g/l IgG, 1-10 g/l IgA and 0.2-3 g/l IgM immunoglobulins at a pH value of about 7.3 to about 7.8 and an osmolarity of about 200-350 mosmol/kg.

29. The perfusion solution of any one of claims 24-28, wherein the concentration of L-glutamine is 2.5 mM.

30. The perfusion solution of any one of claims 24-28, wherein the concentration of L-glutamine is 5 mM.

31. The perfusion solution of any one of claims 24-28, wherein the concentration of L-glutamine is 7.5 mM.

32. The perfusion solution of any one of claims 24-31, wherein said physiological electrolyte solution comprises the following components: 100-150 mM NaCl; 1-15 mM KCl; 0.1-4 mM $MgSO_4$; 0.5-2 mM KH_2PO_4; 24-48 mM histidin-Cl and 1-3 mM $CaCl_2$.

33. The perfusion solution of claim 32, wherein said physiological electrolyte solution contains 2-10 mM glucose and/or 1-10 mM pyruvate.

34. The perfusion solution of any one of claims 23-33, wherein said physiological electrolyte solution contains 0.1-0.6 U/ml heparin and/or 50-100 µM of each of uric acid and/or ascorbate.

35. The perfusion solution of any one of claims 23-34, wherein the pH value in said physiological electrolyte solution is 7.4 +/- 0.04 under atmospheric condition.

36. The perfusion solution of any one of claims 24-35, wherein said endothelium-protective perfusion solution further contains antibiotics.

37. The perfusion solution of claim 36, wherein said antibiotics are 50-400 U/ml penicillin and/or 0.1-0.4 mg/ml streptomycin.

38. The perfusion solution of claim 24, wherein said perfusion solution is an anti-coagulatory and non-agglutinating blood plasma preparation, comprising human plasma proteins, anti-coagulatory-acting factors and immunoglobulins, and in which the pro-coagulatory-acting factors, isoagglutinins and instable components of the blood plasma have been removed.

39. The method of claim 38, wherein the blood plasma preparation comprises the following components: 100-170 sodium ions, 1-15 mM potassium ions, 1-6 mM calcium ions, about 0.1-4 mM magnesium ions, 50-200 mM chloride ions, 25-45 g/l albumin, 3-15 g/l IgG, 1-10 g/l IgA and 0.2-3 g/l IgM immunoglobulins.

40. The perfusion solution of claim 39, wherein the blood plasma preparation was treated with β-propiolactone and UV-radiation for virus inactivation.

41. The perfusion solution of any one of claims 24-40, wherein said perfusion solution contains one or more endothelium-promoting growth factors.

42. The perfusion solution of claim 41, wherein said growth factor is selected from the group consisting of epidermal growth factor (EGF), fibroblast growth factor (FGF), vascular endothelial growth factor (VEGF) and stem cell factor (SCF).

43. The perfusion solution of any one of claims 25-42, wherein said perfusion solution contains flavonoids.

44. The perfusion solution of claim 43, wherein the flavonoid is quercetin and/or trihydroxyethyl rutoside.

45. The perfusion solution of any one of claims 25-44, wherein said perfusion solution contains papaverin and/or adenosine.

46. The perfusion solution of any one of claims 25-45, wherein said perfusion solution contains cardioplegic concentrations of potassium of more than 6 mM.

47. An apparatus for the endothelium-preserving treatment of isolated biological vessels comprising a chamber (1), an axially movable stamp (6), a cannula (5), a reservoir container (7), which contains the endothelium-preserving perfusion liquid and a sealing device (3), wherein the cannula is connected with the axially moveable stamp (6) such that the cannula can be moved together with the stamp into the chamber, and wherein the sealing device (3) can clasp one end of the vessel and the cannula is connected with the other end of the vessel such that the endothelium-protective perfusion solution can be selectively directed into the biological vessel from the reservoir container (7), preferably under a pressure gradient.

48. The apparatus of claim 47, wherein said sealing device comprises sealing discs which are arranged in stacks in a knurled thumb screw.

49. The apparatus of claim 48, wherein the sealing discs have a diameter of 1-10 mm and/or a thickness of 0.3-3 mm.

50. The apparatus of any one of claims 47-49, wherein said apparatus further contains a thermostat device for heating the perfusion liquid.

51. The apparatus of any one of claims 47-50, wherein said endothelium-protective perfusion solution is any one as defined in any one of claims 24-46.

52. Use of an endothelium-protective perfusion solution according to any one of claims 24-46 for the preservation of endothelium in isolated hollow organs or biological vessels.

53. Use of an endothelium-protective perfusion solution according to any one of claims 24-46 for maintenance and/or repair of endothelial tissue in isolated hollow organs or biological vessels.

54. Use of an endothelium-protective perfusion solution according to any one of claims 24-46 for therapy and/or prevention of vascular obliterations in isolated hollow organs or biological vessels.